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Armstrong et al.

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(54) LOGICAL PARTITION MANAGER AND METHOD

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(52) **U.S. Cl.** **709/100**; 709/329; 709/224
(58) **Field of Search** 709/1, 100, 224, 709/301, 329, 310; 395/500; 710/5; 707/513

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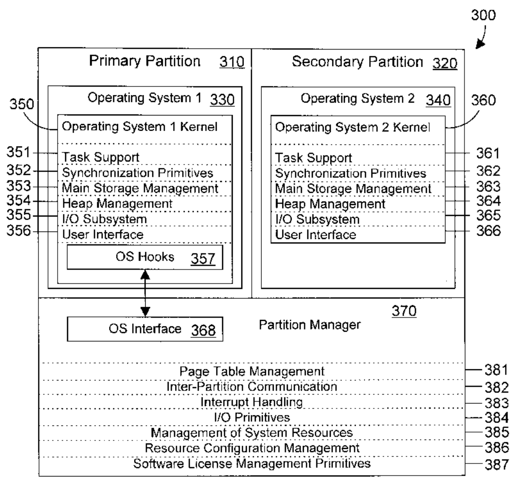
(57) **ABSTRACT**

A partition manager for managing logical partitions in a computer system includes hooks to low-level operating system code in one of the logical partitions. By using the operating system code to manage the resources of a computer system, any changes that are made to the operating system are automatically reflected in the function of the partition manager. In addition, low-level functions of operating systems, which are often well-debugged and tested, can be used when generating a new partition manager, greatly simplifying the time and reducing the cost of producing a partition manager.

27 Claims, 5 Drawing Sheets


300
Primary Partition 310
Secondary Partition 320
Operating System 1 330
Operating System 2 340
350
360
Operating System 1 Kernel
Operating System 2 Kernel
351 Task Support
352 Synchronization Primitives
353 Main Storage Management
354 Heap Management
355 I/O Subsystem
356 User Interface
OS Hooks 357
361 Task Support
362 Synchronization Primitives
363 Main Storage Management
364 Heap Management
365 I/O Subsystem
366 User Interface
OS Interface 368
Partition Manager 370
Page Table Management 381
Inter-Partition Communication 382
Interrupt Handling 383
I/O Primitives 384
Management of System Resources 385
Resource Configuration Management 386
Software License Management Primitives 387

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U.S. Patent Application RO999–022, "Processor Reset Generated via Memory Access Interrupt," filed May 19, 1999, Armstong et al.

U.S. Patent Application RO999–023, "Management of a Concurrent Use License in a Logically–Partitioned Computer," filed May 19, 1999, Armstong et al.

U.S. Patent Application RO999–024, "Event–Driven Communications Interface for Logically–Partitioned Computer," filed May 19, 1999, Armstong et al.

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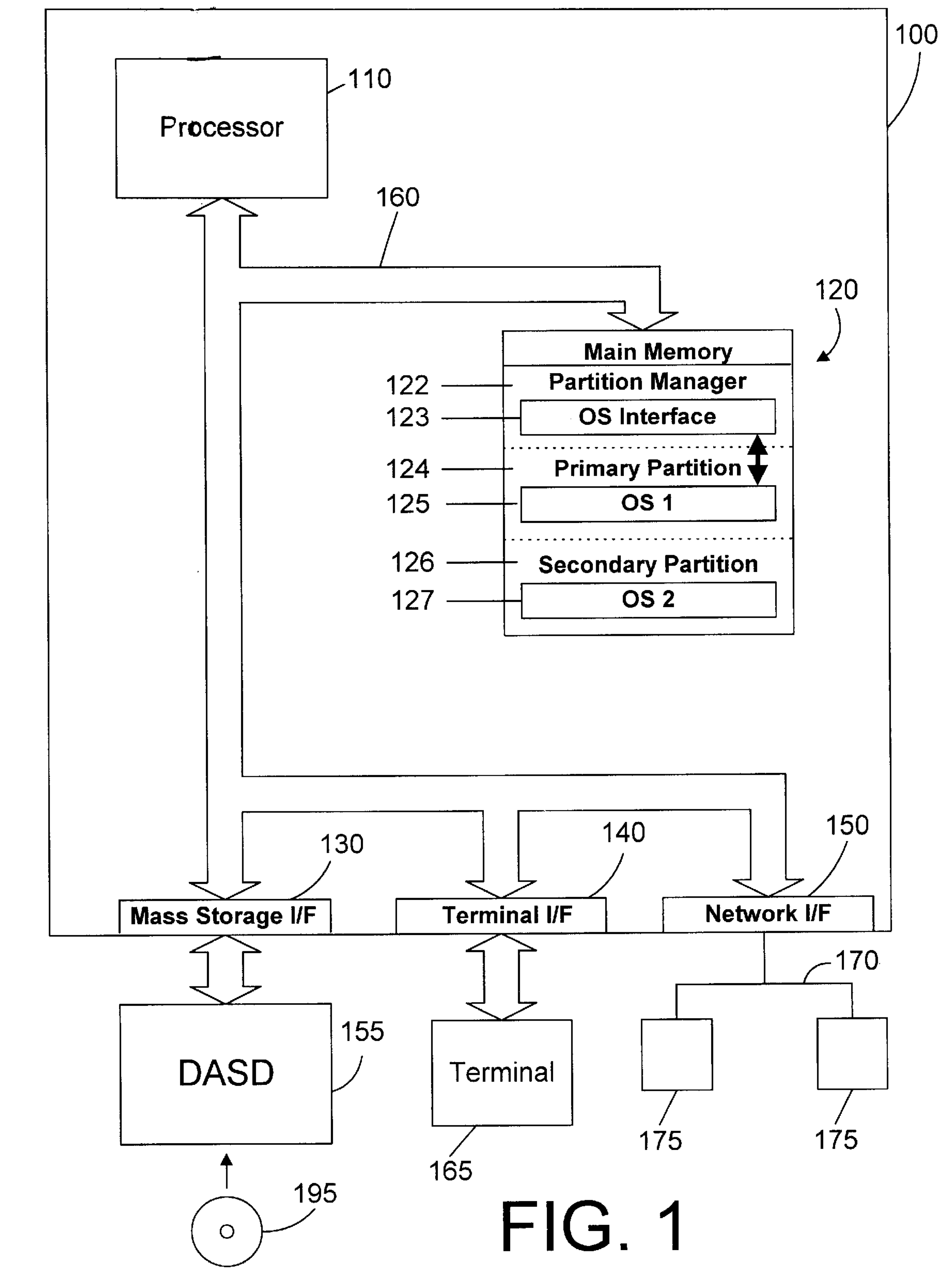
100
110
Processor
160
120
Main Memory
122
Partition Manager
123
OS Interface
124
Primary Partition
125
OS 1
126
Secondary Partition
127
OS 2
130
140
150
Mass Storage I/F
Terminal I/F
Network I/F
170
155
DASD
Terminal
175
175
165
195

FIG. 1

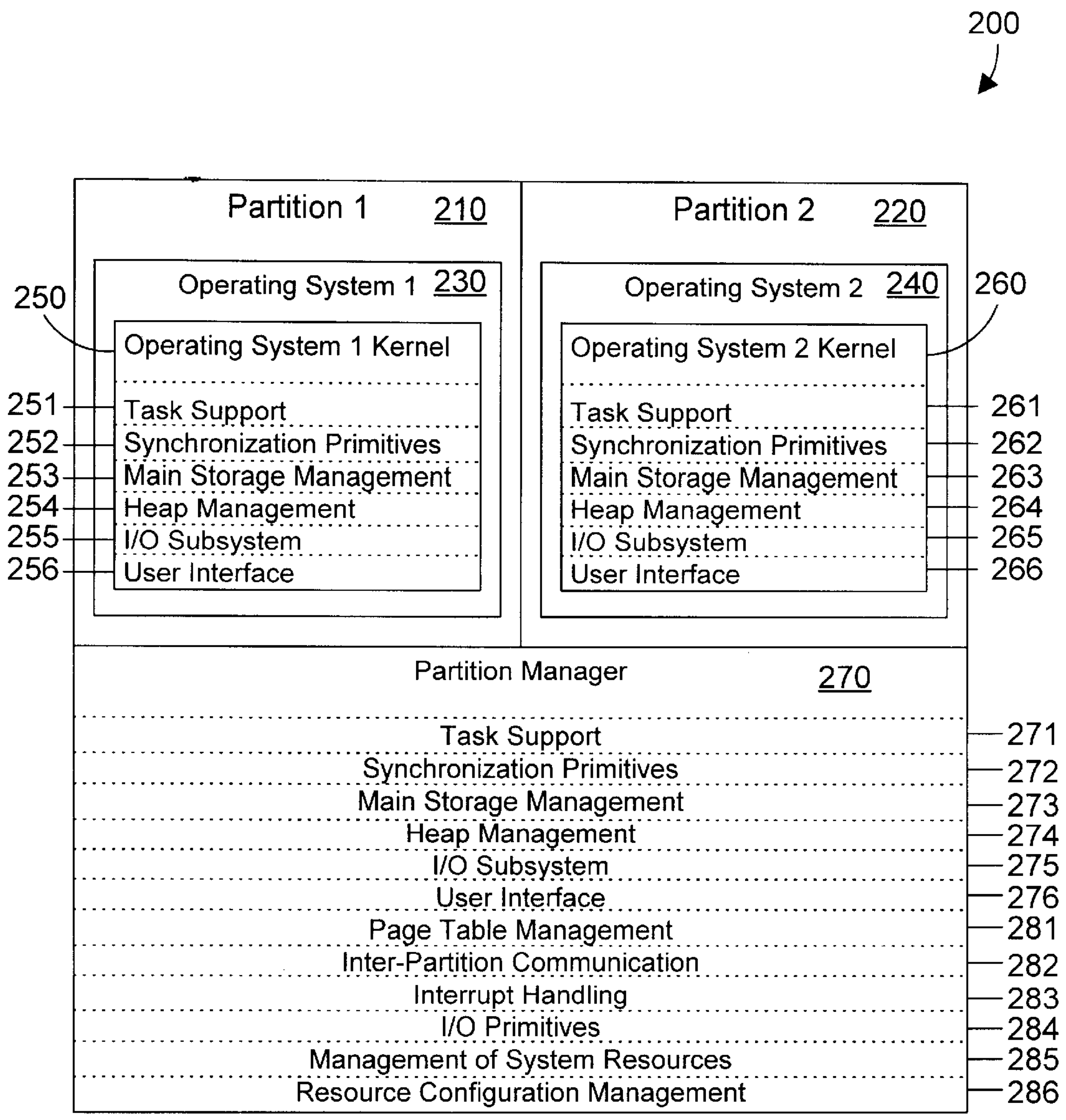

FIG. 2 PRIOR ART

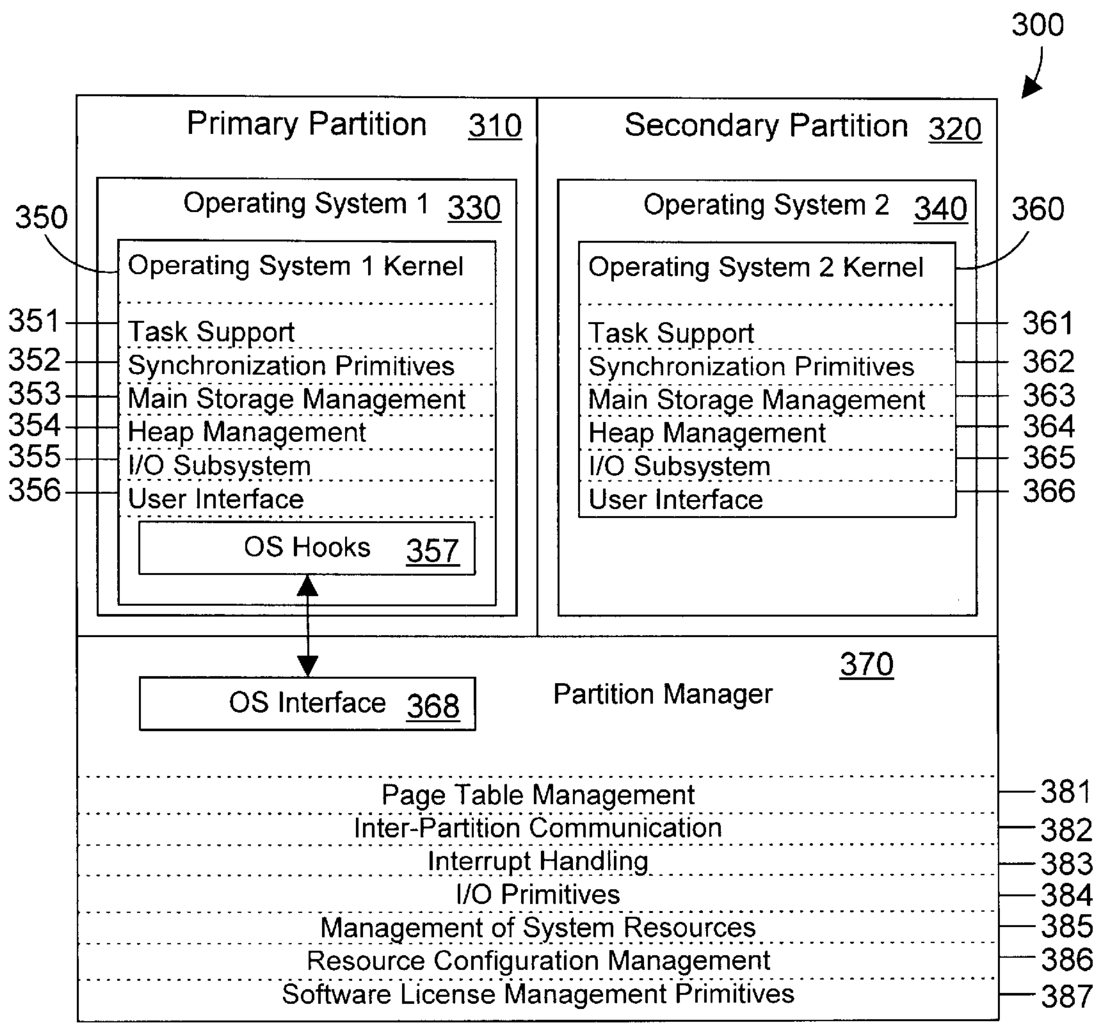
300
Primary Partition 310
Secondary Partition 320
Operating System 1 330
Operating System 2 340
350
360
Operating System 1 Kernel
Task Support
Synchronization Primitives
Main Storage Management
Heap Management
I/O Subsystem
User Interface
OS Hooks 357
351
352
353
354
355
356
Operating System 2 Kernel
Task Support
Synchronization Primitives
Main Storage Management
Heap Management
I/O Subsystem
User Interface
361
362
363
364
365
366
370
Partition Manager
OS Interface 368
Page Table Management
Inter-Partition Communication
Interrupt Handling
I/O Primitives
Management of System Resources
Resource Configuration Management
Software License Management Primitives
381
382
383
384
385
386
387

FIG. 3

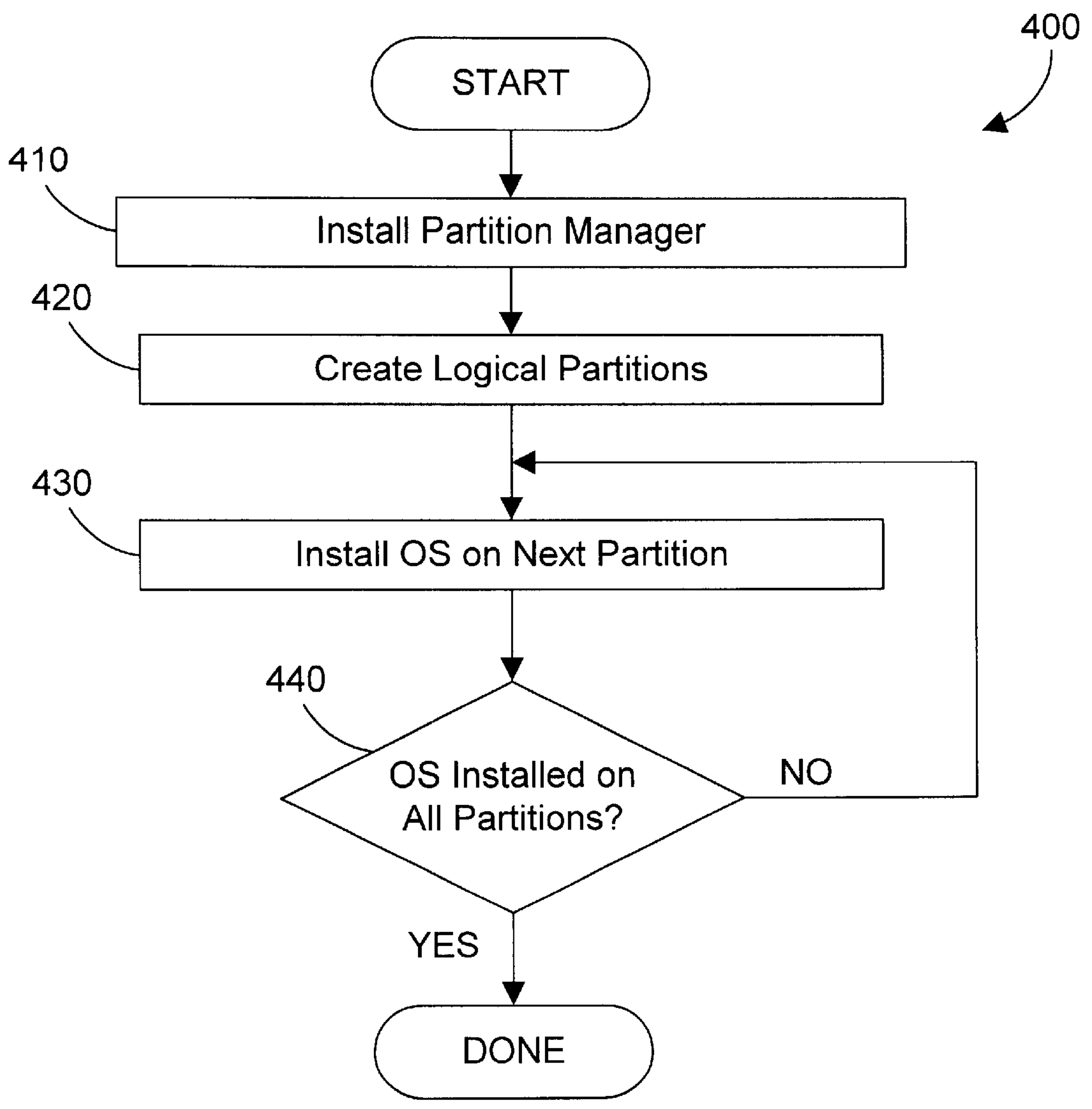
400
START
410
Install Partition Manager
420
Create Logical Partitions
430
Install OS on Next Partition
440
OS Installed on All Partitions?
NO
YES
DONE

FIG. 4 PRIOR ART

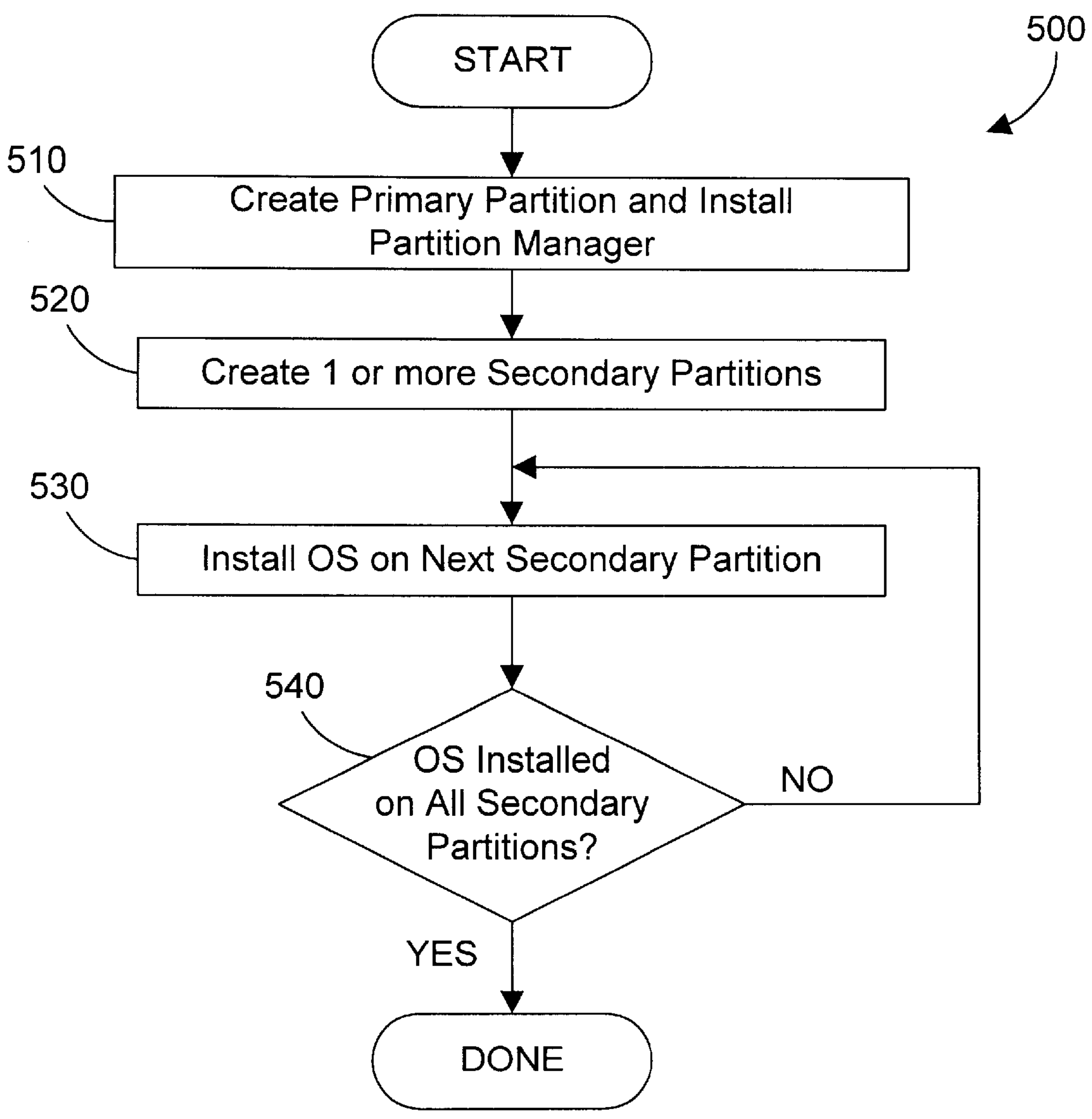
500
START
510
Create Primary Partition and Install Partition Manager
520
Create 1 or more Secondary Partitions
530
Install OS on Next Secondary Partition
540
OS Installed on All Secondary Partitions?
NO
YES
DONE

FIG. 5

LOGICAL PARTITION MANAGER AND METHOD

RELATED APPLICATIONS

This patent application is related to the following patent applications: U.S. patent application entitled "Apparatus and Method for Specifying Maximum Interactive Performance in a Logical Partition of a Computer System Independently from the Maximum Interactive Performance in Other Partitions," Ser. No. 09/314,541 filed May 19, 1999 by Armstrong et al.; U.S. patent application entitled "Processor Reset Generated via Memory Access Interrupt," Ser. No. 09/314,769 filed May 19, 1999 by Armstrong et al., now U.S. Pat. No. 6,467,007; U.S. patent application entitled "Management of a Concurrent Use License in a Logically-Partitioned Computer," Ser. No. 09/314,324 filed May 19, 1999 by Armstrong et al.; and U.S. patent application entitled "Event-Driven Communications Interface for Logically-Partitioned Computer," U.S. Pat. No. 6,279,046 issued on Aug. 21, 2002 to Armstrong et al.

BACKGROUND OF THE INVENTION

1. Technical Field

This invention generally relates to data processing, and more specifically relates to logical partitioning in a computer system.

2. Background Art

Since the dawn of the computer age, computer systems have evolved into extremely sophisticated devices that may be found in many different settings. Computer systems typically include a combination of hardware (e.g., semiconductors, circuit boards, etc.) and software (e.g., computer programs). As advances in semiconductor processing and computer architecture push the performance of the computer hardware higher, more sophisticated computer software has evolved to take advantage of the higher performance of the hardware, resulting in computer systems today that are much more powerful than just a few years ago.

The combination of hardware and software on a particular computer system defines a computing environment. Different hardware platforms and different operating systems thus provide different computing environments. In recent years, engineers have recognized that it is possible to provide different computing environments on the same physical computer system by logically partitioning the computer system resources to different computing environments. The AS/400 computer system developed by IBM is an example of a computer system that supports logical partitioning. If logical partitioning on an AS/400 is desired, partition manager code (referred to as a "hypervisor" in AS/400 terminology) is installed that allows defining different computing environments on the same platform. Once the partition manager is installed, logical partitions may be created that define different computing environments. The partition manager manages the logical partitions to assure that they can share needed resources in the computer system while maintaining the separate computing environments defined by the logical partitions.

In a computer system with no logical partitions, a partition manager is not needed, and the operating system controls access to the computer system resources. In a computer system that has one or more logical partitions, the partition manager controls access to the computer system resources, and the operating systems installed in each logical partition uses the partition manager to perform its functions. Because

both the operating system and the partition manager must be able to manage the resources in a computer system, the low-level functions of an operating system are typically implemented in a partition manager as well. In known systems, the partition manager is separate from the operating system, and the partition manager is generally maintained separately from the operating system. Because they share similar functions, a change to a common function in one will typically require a corresponding change in the other. Without a mechanism that supports logical partitioning in a more efficient manner, the programming of partition managers and the separate maintenance of operating systems and partition managers will continue to be a drain on resources in the computer industry.

DISCLOSURE OF INVENTION

According to the present invention, a partition manager for managing logical partitions in a computer system includes hooks to low-level operating system code in one of the logical partitions. By using the operating system code to manage the resources of a computer system, any changes that are made to the operating system are automatically reflected in the function of the partition manager. In addition, low-level functions of operating systems, which are often well-debugged and tested, can be used when generating a new partition manager, greatly simplifying the time and reducing the cost of producing a partition manager.

The foregoing and other features and advantages of the invention will be apparent from the following more particular description of preferred embodiments of the invention, as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

The preferred embodiments of the present invention will hereinafter be described in conjunction with the appended drawings, where like designations denote like elements, and:

FIG. **1** is a block diagram of a computer apparatus that supports logical partitioning in accordance with the preferred embodiments;

FIG. **2** is a block diagram showing a sample prior art system that has two logical partitions;

FIG. **3** is a block diagram showing a system in accordance with the preferred embodiments that has two logical partitions;

FIG. **4** is a flow diagram illustrating a known method for logically partitioning a computer system; and

FIG. **5** is a flow diagram illustrating a method for logically partitioning a computer system in accordance with the preferred embodiments.

BEST MODE FOR CARRYING OUT THE INVENTION

According to preferred embodiments of the present invention, a computer system that supports logical partitioning includes a partition manager that uses hooks to an operating system in one of the logical partitions to accomplish the low-level control of the computer system. By using operating system functions, the size of the partition manager is greatly reduced, and the maintainability of the partition manager is significantly enhanced.

Referring to FIG. **1**, a computer system **100** is an enhanced IBM AS/400 computer system, and represents one suitable type of computer system that supports logical partitioning in accordance with the preferred embodiments. Those skilled in the art will appreciate that the mechanisms and apparatus of the present invention apply equally to any computer system that supports logical partitions. As shown in FIG. **1**, computer system **100** comprises a processor **110** connected to a main memory **120**, a mass storage interface **130**, a terminal interface **140**, and a network interface **150**. These system components are interconnected through the use of a system bus **160**. Mass storage interface **130** is used to connect mass storage devices (such as a direct access storage device **155**) to computer system **100**. One specific type of direct access storage device is a CD-ROM drive, which may read data from a CD-ROM **195**.

Main memory **120** contains a partition manager **122** that manages a primary partition **124** and one or more secondary partitions **126**, both of which are logical partitions. The primary partition **124** includes an operating system **125**, and the secondary partition **126** includes an operating system **127**. The partition manager **122** includes an interface **123** to the operating system **125** in the primary partition **124**. In this manner the partition manager **122** uses code that already exists within operating system **125** instead of duplicating this code to perform its partition management functions.

Operating system **125** is a multitasking operating system known in the industry as OS/400; however, those skilled in the art will appreciate that the spirit and scope of the present invention is not limited to any one operating system. Any suitable operating system can be used. Operating system **125** is a sophisticated program that contains low-level code to manage the resources of computer system **100**. Some of these resources are processor **110**, main memory **120**, mass storage interface **130**, terminal interface **140**, network interface **150**, and system bus **160**. The operating system **127** in each secondary partition **126** may be the same as the operating system **125** in the primary partition **124**, or may be a completely different operating system. Thus, primary partition **124** can run the OS/400 operating system, while secondary partition **126** can run another instance of OS/400, possibly a different release, or with different environment settings (e.g., time zone). The operating system **127** in the secondary partition **126** could even be different than OS/400, provided it is compatible with the hardware and the operating system interface **123**. In this manner the logical partitions can provide completely different computing environments on the same physical computer system.

The partitions **124** and **126** are shown in FIG. **1** to reside within the main memory **120**. However, one skilled in the art will recognize that a partition is a logical construct that includes resources other than memory. A logical partition typically specifies a portion of memory, along with an assignment of one or more processors and other system resources. Thus, primary partition **124** could be defined to include two processors and a portion of memory **120**, along with one or more I/O processors that can provide the functions of mass storage interface **130**, terminal interface **140**, network interface **150**, or interfaces to other I/O devices. The secondary partition **126** could then be defined to include three other processors, a different portion of memory **120**, and one or more I/O processors. The partitions are shown in FIG. **1** to symbolically represent logical partitions, which would include system resources outside of memory **120** within computer system **100**.

Computer system **100** utilizes well known virtual addressing mechanisms that allow the programs of computer system **100** to behave as if they only have access to a large, single storage entity instead of access to multiple, smaller storage entities such as main memory **120** and DASD device **155**. Therefore, while partition manager **122** and the partitions **124** and **126** are shown to reside in main memory **120**, those skilled in the art will recognize that these items are not necessarily all completely contained in main memory **120** at the same time. It should also be noted that the term "memory" is used herein to generically refer to the entire virtual memory of computer system **100**.

Processor **110** may be constructed from one or more microprocessors and/or integrated circuits. Processor **110** executes program instructions stored in main memory **120**. Main memory **120** stores programs and data that processor **110** may access. When computer system **100** starts up, processor **110** initially executes the program instructions that make up the partition manager **122**, which initializes the operating systems in the logical partitions.

Although computer system **100** is shown to contain only a single processor and a single system bus, those skilled in the art will appreciate that the present invention may be practiced using a computer system that has multiple processors and/or multiple buses. In addition, the interfaces (called input/output processors in AS/400 terminology) that are used in the preferred embodiment each include separate, fully programmed microprocessors that are used to off-load compute-intensive processing from processor **110**. However, those skilled in the art will appreciate that the present invention applies equally to computer systems that simply use I/O adapters to perform similar functions.

Terminal interface **140** is used to directly connect one or more terminals **165** to computer system **100**. These terminals **165**, which may be non-intelligent (i.e., dumb) terminals or fully programmable workstations, are used to allow system administrators and users to communicate with computer system **100**. Note, however, that while terminal interface **140** is provided to support communication with one or more terminals **165**, computer system **100** does not necessarily require a terminal **165**, because all needed interaction with users and other processes may occur via network interface **150**.

Network interface **150** is used to connect other computer systems and/or workstations (e.g., **175** in FIG. **1**) to computer system **100** across a network **170**. The present invention applies equally no matter how computer system **100** may be connected to other computer systems and/or workstations, regardless of whether the network connection **170** is made using present-day analog and/or digital techniques or via some networking mechanism of the future. In addition, many different network protocols can be used to implement a network. These protocols are specialized computer programs that allow computers to communicate across network **170**. TCP/IP (Transmission Control Protocol/Internet Protocol) is an example of a suitable network protocol.

At this point, it is important to note that while the present invention has been and will continue to be described in the context of a fully functional computer system, those skilled in the art will appreciate that the present invention is capable of being distributed as a program product in a variety of forms, and that the present invention applies equally regardless of the particular type of signal bearing media used to actually carry out the distribution. Examples of suitable signal bearing media include: recordable type media such as floppy disks and CD ROM (e.g., **195** of FIG. **1**), and transmission type media such as digital and analog communications links.

Referring to FIG. **2**, a computer system **200** is shown that is partitioned into two logical partitions using prior art techniques. A partition manager **270** is used to manage two logical partitions **210** and **220**. Each logical partition includes a corresponding operating system **230** and **240**, and each operating system includes a kernel **250** and **260** that performs the low-level functions of the operating system. The operating system kernel **250** includes task support **251**, synchronization primitives **252**, main storage management **253**, heap management **254**, an I/O subsystem **255**, and a user interface **256**. In similar fashion, operating system kernel **260** includes corresponding elements **261–266** as well. These items are discussed below with reference to operating system **230**, recognizing that this description for the kernel functions of operating system **230** applies to operating system **240** as well.

Task support **251** is the part of operating system **230** that manages tasks. A task is a small piece of work (also known as a "job") that needs to be performed. Task support **251** allocates system resources, as required, to perform tasks, and initiates the execution of those tasks. Synchronization primitives **252** provide support for communicating between tasks, and may include message queues, locks on shared data, and other mechanisms for communicating between tasks.

Main storage management **253** is the part of operating system **230** that manages the portion of main memory that corresponds to partition **210**. Heap management **254** manages a special storage area in memory known as the "heap". A heap is storage that may be allocated and de-allocated dynamically. When operating system **230** needs memory allocated for a task, heap management **254** can allocate a portion of the heap to the task, and after the task has been performed, heap management **254** returns the used memory back to the heap.

I/O subsystem **255** is the portion of operating system **230** that controls input/output devices of a computer system. User interface **256** is an interface for a user to interact with operating system **230**.

A partition manager **270** provides the low-level control of computer system **200**. Partition manager **270** includes task support **271**, synchronization primitives **272**, main storage management **273**, heap management **274**, an I/O subsystem **275**, and a user interface **276**, which are similar to the corresponding elements **251–256** of the same names in the kernel **250** of operating system **230**. The reason that partition manager **270** needs to provide these same functions is clear: when an operating system is installed in a logical partition, it no longer has complete control of the computer system, but must share control with the operating systems in other logical partitions. The low-level functions that were previously performed by the operating systems must now be performed by the partition manager, which interacts with the operating systems in the logical partitions to perform the requested functions as needed. In addition, partition manager **270** typically does not know the services provided by the operating system, or how to invoke them, so the services must be provided by the partition manager itself. For these reasons, partition manager **270** includes functions in items **271–276** that are already performed in operating system **230**.

In addition to items **271–276**, partition manager **270** also includes mechanisms for page table management **281**, inter-partition communication **282**, interrupt handling **283**, I/O primitives **284**, management of system resources **285**, and resource configuration management **286**. Page table management **281** is the mechanism that ensures each partition only accesses the portion of main memory that it owns. The logical partition must call the page table management code in order to establish addressability to a page of main memory. An inter-partition communication mechanism **282** provides for high-speed communication between logical partitions without the data having to travel outside the computer system **200**. Interrupt handling **283** provides a mechanism for handling interrupts in a computer system. I/O primitives **284** provide the low-level code that drives input/output devices. Management of system resources **285** manages system-wide resources that need to be shared between logical partitions. The system clock is an example of a system resource that would be managed by the management of system resources **285**. Resource configuration management **286** determines the configuration of the computer system resources for each of the logical partitions. In other words, resource configuration management **286** keeps track of resources belonging to each logical partition.

Prior art system **200** as shown in FIG. **2** includes a significant amount of code in each operating system kernel, and provides code for performing many similar functions in the partition manager **270**. Providing similar functions in partition manager **270** and operating system kernel **250** means that a change to the I/O subsystem **255** of operating system kernel **250** to accommodate a new hardware bus structure will require a corresponding change to the I/O subsystem **275** of partition manager **270**. Maintaining two different programs that perform such similar functions is wasteful of time and resources by duplicating the development and testing efforts for these similar functions.

Referring now to FIG. **3**, a computer system **300** in accordance with the preferred embodiments is preferably a computer system similar to **100** in FIG. **1**, with the logical partitions shown in FIG. **3**. A primary partition **310** provides an operating system **330** that has a kernel **350**. Kernel **350** suitably includes mechanisms **351–356** that are similar to the corresponding mechanisms **251–256** shown in FIG. **2**. Kernel **350** also provides operating system hooks **357** that allow a program to use functions defined in the operating system by making certain calls to the operating system via OS hooks **357**. Partition **310** is referred to herein as a "primary partition" because it contains an operating system **330** that may be used by partition manager **370** to perform certain functions. All other partitions are referred to herein as "secondary partitions".

A partition manager **370** includes mechanisms **381–386** that are suitably similar to the corresponding elements **281–286** shown in FIG. **2**. In addition, partition manager **370** includes software license management primitives **387** that allow partition manager **370** to track the number of users across logical partitions to enforce software licenses. Partition manager **370** also includes an operating system interface **368** that calls OS hooks **357** to perform many of the functions for the partition manager **370**. Instead of providing separate code within partition manager **370** to provide task support, synchronization primitives, main storage management, heap management, I/O subsystem, and a user interface, partition manager **370** uses the mechanisms **351–356** that already reside in the kernel **350** of the operating system **330** in the primary partition **310**. This approach has several advantages.

Many computer systems have operating systems that are well-defined and have been debugged over years of time. If an operating system with a reliable kernel is available, a programmer can implement a partition manager **370** by simply making calls to well-defined and tested hooks into the operating system, rather than re-implementing similar functions from scratch. Thus, by providing OS interface **368** and OS hooks **357**, partition manager **370** may benefit from the functions already provided in the operating system **330**. This greatly reduces the amount of programming required to implement the partition manager **370**, and greatly reduces the time required to debug and test partition manager **370**. The present invention thus results in substantially reducing the costs of developing a partition manager for a computer system.

Note that the kernel **350** of an operating system **330** may include many other functions not listed in FIG. **3**, and may include a subset of the functions shown. The functions in the operating systems **330** and **340** of FIG. **3** are shown by way of example to illustrate some of the many possible functions that could be present in an operating system kernel. In addition, the functions **381**–**387** of partition manager **370** are shown as suitable examples of functions that may be implemented, and any subset of these functions, as well as other suitable functions not shown, may be implemented within partition manager **370** within the scope of the present invention. One skilled in the art will appreciate that numerous other functions could be incorporated within an operating system kernel or within a partition manager within the scope of the present invention.

Because the partition manager **370** in computer system **300** of FIG. **3** uses functions provided by an operating system in the primary partition **310**, the method for installing the partition manager **370** and the logical partitions **310** and **320** differs from methods known in the prior art. First, the prior art method **400** is explained with reference to FIG. **4**.

In the prior art, when one or more logical partitions are desired on a computer system, first the partition manager is installed (step **410**). Next, the logical partitions are created (step **420**). An operating system is then installed on a partition (step **430**). If an operating system has been installed on all logical partitions (step **440**=YES), the installation method is complete. If there still remain logical partitions without operating systems (step **440**=NO), an operating system is installed on the next logical partition (step **430**), and steps **430** and **440** are repeated until an operating system has been installed on all logical partitions (step **440**=YES).

Referring now to FIG. **5**, a method **500** for partitioning a computer system in accordance with the present invention starts by creating a primary partition and installing the partition manager (step **510**). The partition manager is then used to create one or more secondary partitions (step **520**). An operating system is then installed on a secondary partition (step **530**). If an operating system has been installed on all secondary partitions (step **540**=YES), method **500** is complete. If there remain secondary partitions without operating systems installed, steps **530** and **540** are repeated until all secondary partitions have an installed operating system (step **540**=YES).

The reason that step **510** of FIG. **5** creates the primary partition and installs the partition manager is that the preferred embodiment of the invention packages partition manager **370** as part of operating system **330**. Thus, the process for installing the operating system **330** will include prompts for information relating to partition manager **370** as well. This means that a software installer may use the same familiar interface for the operating system to install both the operating system and the partition manager **370**. Note that installing the same operating system on the secondary partition **320** will include the partition manager code, but this code will not be used because it resides in a secondary partition.

The present invention as described above comprises a partition manager that uses functions provided by an operating system residing in a logical partition. By using existing code in the operating system to perform these low-level functions, duplication of code is prevented, and code maintenance is greatly improved. In addition, the user interface and procedures for maintaining the partition manager are the same as used to maintain the operating system in the primary partition, greatly simplifying the maintenance of the partition manager of the present invention when compared with maintaining known partition managers.

One skilled in the art will appreciate that many variations are possible within the scope of the present invention. Thus, while the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that these and other changes in form and details may be made therein without departing from the spirit and scope of the invention.

We claim:

1. An apparatus comprising:

at least one processor;

a memory coupled to the at least one processor;

a plurality of logical partitions defined on the apparatus, each logical partition including an operating system and a portion of the at least one processor and a portion of the memory; and

a partition manager for managing the use of computer system resources by the plurality of logical partitions, the partition manager including at least one call to a kernel of the operating system residing in a preselected one of the logical partitions, the call resulting in the execution of a plurality of instructions in the kernel by the partition manager to perform at least one kernel function for the partition manager.

2. The apparatus of claim **1** wherein the operating system kernel in the preselected logical partition includes hooks that may be called by the at least one call of the partition manager.

3. The apparatus of claim **1** wherein the at least one kernel function comprises task support functions and synchronization primitives.

4. The apparatus of claim **3** wherein the at least one kernel function further comprises main storage management functions and heap management functions.

5. The apparatus of claim **4** wherein the at least one kernel function further comprises an input/output (I/O) subsystem.

6. The apparatus of claim **5** wherein the at least one kernel function further comprises a user interface.

7. The apparatus of claim **6** wherein the partition manager provides software license management primitives for tracking a total number of users across the plurality of partitions.

8. The apparatus of claim **1** wherein the at least one kernel function comprises main storage management functions and heap management functions.

9. The apparatus of claim **1** wherein the at least one kernel function comprises an input/output (I/O) subsystem.

10. The apparatus of claim **1** wherein the at least one kernel function comprises a user interface.

11. The apparatus of claim **1** wherein the partition manager provides software license management primitives for tracking a total number of users across the plurality of partitions.

12. An apparatus comprising:

at least one processor;

a memory coupled to the at least one processor;

a plurality of logical partitions defined on the apparatus, each logical partition including an operating system and a portion of the at least one processor and a portion of the memory; and partition manager means for managing the use of computer system resources by the plurality of partitions, the means including at least one call to a kernel of the operating system residing in a preselected one of the logical partitions, the call resulting in the execution of a plurality of instructions in the kernel by the partition manager to perform at least one kernel function for the partition manager.

13. A computer-implemented method for creating at least one logical partition on a computer system, the method comprising the steps of:

(A) creating a first logical partition;

(B) installing a partition manager for managing the use of computer system resources by the at least one logical partition, the partition manager including at least one call to a kernel of an operating system that will be installed in the first logical partition, the call resulting in the execution of a plurality of instructions in the kernel by the partition manager to perform at least one kernel function for the partition manager; and

(C) installing the operating system in the first logical partition.

14. The method of claim 13 further comprising the steps of:

(D) creating another logical partition;

(E) installing an operating system in the logical partition created in step (D); and

(F) repeating steps (D) and (E) until the desired number of logical partitions have been created on the computer system.

15. A computer-implemented method for managing resources on a computer system that has a plurality of logical partitions, the method comprising the steps of:

providing a partition manager that includes at least one call to a kernel of an operating system in a pre-defined logical partition, the call resulting in the execution of a plurality of instructions in the kernel by the partition manager to perform at least one kernel function for the partition manager; and

executing the partition manager to manage the resources in the plurality of logical partitions, the partition manager performing the at least one call to the operating system kernel.

16. A program product comprising:

a partition manager for managing the use of computer system resources by a plurality of logical partitions, the partition manager including at least one call to a kernel of an operating system residing in a preselected one of the logical partitions, the call resulting in the execution of a plurality of instructions in the kernel by the partition manager to perform at least one kernel function for the partition manager; and

computer-readable signal bearing media bearing the partition manager.

17. The program product of claim 16 wherein the signal bearing media comprises recordable media.

18. The program product of claim 16 wherein the signal bearing media comprises transmission media.

19. The program product of claim 16 wherein the at least one kernel function comprises task support functions and synchronization primitives.

20. The program product of claim 19 wherein the at least one kernel function further comprises main storage management functions and heap management functions.

21. The program product of claim 20 wherein the at least one kernel function further comprises an input/output (I/O) subsystem.

22. The program product of claim 21 wherein the at least one kernel function further comprises a user interface.

23. The program product of claim 22 wherein the partition manager provides software license management primitives for tracking a total number of users across the plurality of partitions.

24. The program product of claim 16 wherein the at least one kernel function comprises main storage management functions and heap management functions.

25. The program product of claim 16 wherein the at least one kernel function comprises an input/output (I/O) subsystem.

26. The program product of claim 16 wherein the at least one kernel function comprises a user interface.

27. The program product of claim 16 wherein the partition manager provides software license management primitives for tracking a total number of users across the plurality of partitions.

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